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From: tom kirk <tkirk@bnl.gov>

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To: "Aizenman, Morris" <maizenma@nsf.gov>

CC: "Kirk, Tom" <tkirk@bnl.gov>,  
"Bronson, Arturo" <bronson@materials.utep.edu>,  
"Tyson, J. Anthony" <tyson@lucent.com>,  
"Evans, Billy Joe" <bjemag@umich.edu>,  
"Chorin, Alexandre J." <chorin@math.berkeley.edu>,  
"Gierasch, Lila M." <gierasch@biochem.umass.edu>,  
"Hewitt, Jacqueline" <jhewitt@mit.edu>,  
"Khoury, Bernard V." <bkhoury@aapt.org>,  
"Brisbois, Ronald" <brisbois@macalester.edu>,  
"Chan, Tony" <chan@math.ucla.edu>,  
"Gates, S. James" <gatess@wam.umd.edu>,  
"Goodchild, Fiona" <fiona@mrl.ucsb.edu>,  
"Mathias, Lon" <Lon.Mathias@usm.edu>,  
"Phillips, Julia" <jmphil@sandia.gov>,  
"Siegmond, David" <siegmond@stanford.edu>,  
"Tyson, Neil deGrasse" <tyson@science.amnh.org>,  
"Eisenstein, Bob" <reisenst@nsf.gov>  
Subject: Confirmation of MPS AC Meeting Minutes by the Committee

. June 24, 2001

Dear Morris:

This comes to report that there have been no suggested changes to the draft MPS Advisory Committee (AC) Minutes for the meeting held on April 12-13, 2001. I circulated your submitted version of the Minutes to the AC on June 1, 2001, asking for prompt responses. To date, only one member responded to this call. Accordingly, as Chair of the Committee, I declare that the MPS Advisory Committee has no changes to propose and approves the draft version as the final version.

Sincerely,

Tom Kirk  
MPS AC Chairman

Cc: Advisory Committee Members  
R. Eisenstein

**Directorate for Mathematical and Physical Sciences  
Advisory Committee Meeting Approved Minutes  
April 12-13, 2001**

**Thursday, April 12, 2001  
Morning Session**

*Welcoming Comments and Approval of November, 2000 Minutes*

Dr. Thomas Kirk, Chair of the Mathematical and Physical Sciences Advisory Committee (MPSAC) called the meeting to order at 8:40 AM. The minutes of the November 2000 MPSAC meeting were approved unanimously.

*Update on NSF and MPS Activities*

Dr. Robert Eisenstein, Assistant Director for the Mathematical and Physical Sciences Directorate (MPS), welcomed the MPSAC members and discussed the FY 2002 NSF Budget Request.

The FY 2002 NSF Budget Request is \$4,472,490,000. This is \$56,090,000 (1.3%) over the FY 2001 Current Plan of \$4,416,390,000. The Budget Request encompasses increases in education and human resources (+\$86,790,000, +11.0%), overall salaries and expenses (+\$9,500,000, +5.9%), and the Inspector General's office (+\$490,000, +7.8%). These are balanced out by decreases in Research and Related Activities (-\$15,660,000, -0.5%) and the Major Research Equipment (-\$25,030,000, -20.6%) budget categories.

In terms of the NSF Performance Goals of “People,” “Ideas,” and “Tools” the budget can be characterized as follows:

- 1) *People*: The budget request focuses on improving the link between K-12 education and higher education with a \$200,000,000 increase in Fiscal Year 2002 (of one billion dollars projected over 5 years); and an 11% increase (from \$18,000 to \$20,000) in graduate fellowship stipends (including Graduate Research Fellowships, Graduate Teaching Fellowships, and IGERT).
- 2) *Ideas*: There will be a focus on interdisciplinary mathematics research including the management of large data sets, the modeling of uncertainty, and the modeling and prediction of complex, nonlinear systems. There will also be increased funding (of 3.3% to 16%) in the cross disciplinary areas of Biocomplexity in the Environment (+\$3,220,000, +5.9%), Information Technology and Research (+\$13,100,000, +5.0%), Nanoscale Science and Engineering (+\$24,030,000, +16.1%), and Learning for the 21<sup>st</sup> Century (+\$4,050,000, +3.3%).
- 3) *Tools*: Retention in this fund of three ongoing programs [the National Earthquake Engineering Simulation (NEES), the Large Hadronic Collider (LHC), and the Terascale Computing System (TCS)] with no new starts.

In each of these areas Eisenstein presented examples of activities supported by MPS.

The FY 2002 Budget Request for MPS includes an increase of \$20,000,000 (16.5%) for the Division of Mathematical Sciences. This increase is related to an emphasis on interdisciplinary mathematics. There is an increase of \$7,600,000 (5%) requested for the Division of Astronomical Sciences (AST) budget to cover the \$9,000,000 cost of moving the Atacama Large Millimeter Array (ALMA) project from the Major Research Equipment budget category into the Divisional budget for FY 2002 only. The Division of Chemistry would have level funding compared with Fiscal Year 2001, and there would be decreased funding of about 2% for both the Division of Materials Research (DMR) and the Division of Physics (PHY). The budget for the Office of Multidisciplinary Activities (OMA) would be decreased by 22% from its current level.

Eisenstein described activities supported by the Office of Multidisciplinary Activities. These included astrophysical collaborations between the Division of Astronomical Sciences and the Physics Division, leveraging of research collaborations with educational initiatives, instrument development, support of new research structures, and support of research links to minority-serving institutions. He also described the activities of the MPS and Directorate of Biological Sciences (BIO) Working Group

Eisenstein discussed two potential large facilities developments within MPS. The Atacama Large Millimeter Array (ALMA) project would be a major astronomical observatory designed to image astronomical sources at millimeter wavelengths. “Ice Cube” would be an array of detectors a cubic kilometer in volume embedded in the Antarctic ice and designed to measure the direction and energy of individual neutrinos that interact with the Earth.

Eisenstein then turned to a discussion of activities designed to enhance MPS’ investment in “human capital” through the integration of research and education. These activities ranged from the more than 600 undergraduates participating in research programs at undergraduate universities to summer research experiences for teachers, the Vertical Integration of Graduate Research and Education (VIGRE) and RSEC programs, as well as the MPS International Postdoctoral Program and the Program in Public Science Education. He also described the CAREER and ADVANCE Programs available to faculty just beginning their university research and teaching careers.

In concluding his remarks, Eisenstein thanked the MPS Advisory Committee for their work on the Reinvestment Initiative in Science and Engineering (RISE) document and indicated that it would serve as the model for an NSF-wide document which would be produced in the next few months.

#### *MPS Advisory Committee Discussion*

There was further discussion about the Rare Symmetry Violating Processes (RSVP) Project and the Atacama Large Millimeter Array (ALMA). The RSVP would be a \$100M experimental high-energy physics initiative to be sited at Brookhaven National Laboratory. Its importance for high-energy physics and its complementary relationship to the Large Hadron Collider were noted. This project is not included in the FY 2002 Budget Request. Funds to begin initiation of construction of ALMA were not part of the FY 2002 Budget Request. It was noted that ALMA may well be built to the US design but without US participation if the MRE freeze holds.

There was concern about why the RISE document had not had wider distribution. Eisenstein reiterated that it was being discussed as an NSF-wide concept and that it would take some time before such a document were produced. Could not the activities proposed in the RISE document be initiated on an MPS-wide basis? Eisenstein responded the issues raised in the RISE document cut across most areas of NSF.

A discussion ensued concerning the importance of NSF participating in the construction of a second target station for the Oak Ridge National Laboratory's Spallation Neutron Source (SNS). This was viewed as an effort on the part of MPS effort to keep the (research) community at universities involved in these major projects.

Concern was expressed as to the relatively few number of applications for the new MPS International Postdoctoral Program. This might be due to the manner in which this had been advertised. It was also possible that many individuals seeking postdoctoral appointments considered it risky to go abroad in terms of future employment prospects.

#### *Presentation of the Division of Chemistry Committee of Visitors (COV) Report*

Professor Harry B. Gray of the California Institute of Technology presented the NSF Division of Chemistry Committee of Visitors (COV) Report. Professor Gray thanked the staff of the Chemistry Division for providing support for the COV.

Gray began his report with a discussion entitled “*Where is Chemistry going?*” The main areas of emphasis within the chemistry community have changed and can now be thought of as focused on synthesis, dynamics, analysis, and structure. Specific technical examples were given to illustrate developments in each of those areas as well as the synergy that exists among them. A problem is the chemistry curriculum, which remains much as it was 50 years ago. Theoretical and computational chemistry have the potential to have a major impact on all other areas of chemistry and science. These developments need additional recognition and support.

Gray highlighted four areas as illustrative of major research challenges for the 21<sup>st</sup> Century:

1. CO<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub> reduction, and orchestrating electron flow to control reaction chemistry;
2. H<sub>2</sub>O splitting in relation to areas such as energy storage, charge separation, and achieving what chloroplasts and green leaves know how to do well;
3. C-C, C-N, C-O bond formation and reaction chemistry as being critically important to areas such as materials science; and
4. Non-covalent assembly used to build biological structures and systems

Advancing the chemistry for each of these illustrative areas is enormously important and will require significant support from the core programs of the Division of Chemistry.

Gray then turned to the COV Report. The charge to the COV and the structure of the committee were briefly discussed. The Division of Chemistry was congratulated on an overall, exceptionally high level of performance. The COV was impressed with the dedication and effectiveness of the Program Officers and the Acting Division Director. The Program Officers are working well together. The work supported was of the highest quality.

The staggering workload of the Division was viewed as a serious problem, preventing Program Officers from spending time with the community at important meetings, and limiting the time available to think about the future or their own research interests.

While the COV strongly supports both NSF review criteria, the reviewing community was viewed as not paying enough attention to Criterion 2. This review criterion is relatively new. It was felt that principal investigators do not sufficiently address the broader impact of their work. It was suggested that proposals not discussing the broader impact of proposed work in the main body of the proposal be sent back to the principal investigator so that compliance may increase with time.

The COV found that the Chemistry Division reviews proposals fairly and in a timely manner. The science supported was superb. However, a serious problem was that too much quality work is going unfunded. Gray commented that “There are no marginal proposals at the margin any more.”

The COV found there was no evidence of increasing proposal pressure from groups who had not been in the system previously. The Division has done a nice job of integrating chemistry research and education. However, clear guidelines need to be developed for proposal submission in areas where strong connections are to be made between research and education.

The COV felt that the Chemistry Division has “done a terrific job in building the infrastructure for chemistry research and education by placing key instruments in laboratories in academic institutions all over the country.” But it felt that these instrumentation programs are hard to evaluate and that it was time to have another look at the instrumentation program, and, in particular, the specialized instrumentation needs of individual principal investigators.

The Chemistry Division’s portfolio was viewed as well balanced over the four traditional areas of chemistry: Organic and Macromolecular Chemistry; Physical Chemistry; Inorganic, Bioinorganic and Organometallic Chemistry; Analytical and Surface Chemistry and Advanced Materials Chemistry. However, of critical importance is the matter of the relative investment in individual principal investigators,

centers, and instrumentation. The Division should position itself to invest in research with potential for great impact in the coming years.

The COV felt that Center support needs to be looked at carefully and Center support versus individual PI support needs to be addressed. There was concern that the CAREER program puts too much emphasis on educational innovation. It was stated that young people shouldn't be expected to innovate everywhere, since it would be likely lead to early burnout. The competitive NSF postdoctoral fellowship program should be considered for revival. The fact that no chemistry applications were received for the MPS Distinguished International Post Doctoral Research Fellowship Program was disappointing.

Finally, although the Chemistry Division has an excellent record of providing support for graduate students, new mechanisms for graduate student support are needed. There are enormous demands from industry for well-trained people in chemistry, and this critical chemistry workforce issue needs to be addressed.

*MPS Advisory Committee Discussion of the Chemistry Division's COV Report*

Dr. Fiona Goodchild asked about funding levels for instrumentation. Science teachers appreciate the opportunity to come into laboratories where they can learn about instrumentation. Because support for instrumentation is falling, she recommended that resources be aimed at instrumenting laboratories in universities and colleges to provide better training opportunities for teachers. Gray responded that the placement of instruments for training young people in chemistry is crucial. Given all of the advances in high technology together with advances in instrumentation, there is a real opportunity for achieving high impact through chemistry as an exciting frontier science that interacts with all other science activities.

Dr. David Siegmund commented that too many demands were being made on young people. As the university culture changes, the reward structure for the younger generation is also changing. Gray responded that the NSF CAREER program is an excellent program, and that getting people into research and teaching early is extremely important. Young people learn from other young people, and should be involved in teaching, but there should not be a requirement for them for innovations in teaching and curriculum development. It would be enough if they were just teaching.

Dr. Lila Gierasch commented on two issues regarding instrumentation: reliance on instrumentation to advance science through single investigators, and the need to think about NSF's criterion regarding the use of matching funds to encourage the sharing of instrumentation. Dr. Donald Burland (Acting CHE Division Director) commented that CHE will take a look at the instrumentation program next year.

Dr. Tony Chan asked about the chemistry perspective on the role of mathematics in addressing theory and computation. Gray responded that much work is now being done (e.g., on non-linear problems) and that there is a much larger role here with the increasing integration of science and mathematics. There is an enormous impact on chemistry from both applied and pure mathematics.

Dr. James Gates stated that there is an impedance mismatch problem. In the late 1960s NSF was the only agency to address the integration of synthesis, structure, etc. Gray responded that clearly the 1950's version of the chemistry curriculum is 50 years out of date. With respect to education matters, chemistry is very conservative.

Dr. Neil Tyson responded that restructuring will have to involve tools training and work force tools. This will require funds far beyond what MPS can provide to generate new programs to train graduate students and postdoctoral scholars. There is a need for a national focus area since this is a national problem beyond MPS.

Chan asked if supercomputers are regarded as tools. Gray responded in the affirmative, and said that in areas such as potential surfaces, etc., chemists are using these capabilities, and their needs are growing.

Dr. Billy Joe Evans commented that we are facing a tremendous work force problem. Although many universities are now recruiting from foreign countries, they are not doing so in the U.S. Even with the unique emphasis at NSF on the integration of research and education, research is not being leveraged sufficiently to draw students to the area of chemistry. For example, the NSF Research Experience for Undergraduates (REU) program needs to be evaluated to determine how many of the students show up in graduate schools. Burland responded that a control experiment would need to be done to determine how many REU students not initially committed to graduate school then go on because of the REU program.

Gierasch asked where chemistry graduate students will come from. Gray responded that the decreasing numbers of chemistry majors is due to various things. As an example, he felt that children in K-6 were losing interest in chemistry due to the loss of hands-on experimentation of “chemistry stuff.” Professional societies such as the American Chemical Society (ACS) need to play a larger role in attracting young people into chemistry.

Kirk suggested that the MPSAC withhold approving the COV report until the MPSAC members had met with the Divisions.

*Report on NSF Advisory Committee For Environmental Research and Education (AC-ERE)*

Dr. Donald Burland, Acting Director of the Division of Chemistry, reported on the Environmental Research and Education Advisory Committee on behalf of Dr. Ronald Brisbois, who represents the MPSAC on this Committee and who was unable to attend the current MPSAC meeting. Burland provided background information and a context statement for MPS participation in the Environmental Research and Education focus area. He also referenced the National Science Board report entitled “*Environmental Science and Engineering for the 21<sup>st</sup> Century*” (<http://www.nsf.gov/cgi-bin/getpub?nsb0022>).

The National Research Council report “*Grand Challenges in Environmental Sciences*” (<http://www.nap.edu/books/0309072549/html/>) was discussed at the AC-ERE. Of the eight grand challenges listed in the report, four are presently viewed as critical: Biological diversity and ecosystem functioning, hydrologic forecasting, infectious diseases and the environment, and land-use dynamics.

Burland noted that MPS currently plays a considerable role in the NSF environmental portfolio funding. The level of MPS participation in FY 2000 was approximately 7% of the total NSF investment of \$713,000,000. The MPS role in this NSF focus area emphasizes molecular-level mechanisms.

The 2001 NSF Biocomplexity in the Environment (BE) focus area (<http://www.nsf.gov/pubs/2001/nsf0134/nsf0134.html>) emphasizes four research areas: Dynamics of Coupled Natural and Human Systems (CNH); Coupled Biogeochemical Cycles (CBC); Genome-Enabled Environmental Science and Engineering (GEN-EN); and Instrumentation Development for Environmental Activities (IDEA). Burland stated that MPS is the lead for the last area. Of a total of 390 proposals received in this area in 2001 and currently undergoing review, approximately 50 are related to instrumentation development.

A short history of the Internal BE NSF Working Group was discussed. Each NSF Directorate has a representative on the BE Working Group. The Working Group is presently divided into three subcommittees: strategic plans, cyber infrastructure, and education, communication, diversity.

*Lunch Discussion with NSF Director Dr. Rita Colwell*

Dr. Rita Colwell, Director of the National Science Foundation, joined the Advisory Committee for lunch. She thanked the Committee and told them that its work was deeply appreciated by the Foundation.

She noted that the FY 2002 Budget Request had been crafted after the head of the Office of Management and Budget (OMB) had been appointed. The administration was holding the line on discretionary spending. Highlights of the budget included Interdisciplinary Mathematics, which recognized the

increasing role of mathematics in all scientific fields. Within the Major Research Equipment (MRE) request there were no new projects, only ongoing activities.

She noted that OMB has requested a report on whether astronomical activities at NSF should be transferred to the National Aeronautics and Space Administration (NASA). This report would be provided by a panel under the auspices of the National Academy of Sciences. Dr. Norman Augustine had been appointed the Chair of this panel.

Colwell emphasized the need of the science community to speak for all of science when speaking to Congress and the public. She stated that it was critical for the NSF budget to increase, and that NSF supported 50% of non-medical research in colleges and universities. NSF supports approximately 200,000 people through its programs.

Colwell also took note of the increasing activities initiated between the Directorate for Biological Sciences (BIO) and MPS. She also noted that MPS was the lead element in the current mathematics/sciences initiative. With respect to graduate education, she felt that current graduate stipends provided by NSF were much too small and would like to see them increase to about \$25,000 annually by FY 2002 or FY 2003. She would also like to see an increase in postdoc stipends.

During the discussion period, Gates asked how MPS scientists could be better advocates for the core sciences. Colwell replied that they should get on and give talks at business lunches and convey to business people the importance of science. These were the people who talked to Congress. Tony Tyson noted that the populace appeared to be disconnected from science, and that NSF should try to reach out and connect to the general public. Colwell noted that the Head of the Office of Legislative and Public Affairs, Curt Suplee, was working on creating an NSF web site for science. She also urged the community to inform NSF when press releases were issued on work supported by NSF. Gierasch commented on the MPSAC activities with respect to the RISE document, and wondered what was happening to the document. Colwell responded that she was enthusiastic about the document, that NSF wanted to make use of the document, and that the sooner an NSF-wide version appeared, the better.

Following some further discussion, the Advisory Committee expressed its thanks to Dr. Colwell for taking the time to join them and for her efforts in support of basic research.

#### **Thursday, April 12, 2001**

##### **Afternoon Session**

###### *Invited Presentation I*

Dr. Martin Blume, Editor-in-Chief of the American Physical Society and Senior Physicist at Brookhaven National Laboratory gave an invited presentation entitled “*Physics Journals, Electronic Publishing, and Uses of the Internet for Scientific Education.*” The abstract of Dr. Blume’s talk is presented below:

“The American Physical Society, publishers of the Physical Reviews and Reviews of Modern Physics, has provided all of its journals electronically for several years. In addition, back volumes of our journals are being scanned into electronic form back to their beginnings in 1893. Many famous scientific developments were first announced in their pages, and these can now be collected and searched in a way that will provide many opportunities for undergraduate and graduate educational uses. Further, the use of physics “portals” for teaching can be enhanced by links to these original articles. There are many opportunities and challenges in this electronic future. With a live Internet demonstration and good luck the former will be illustrated. So too, with bad luck, for the latter.”

###### *Invited Presentation II*

Dr. Lawrence Krauss and Dr. Cyrus Taylor of Case Western Reserve University gave an invited presentation entitled “*Physics and Entrepreneurship.*” The abstract of their talk is presented below:

“The Department of Physics at Case Western Reserve University, in cooperation with the Entrepreneurship Division of the Weatherhead School of Management, has launched a new Master's level program in Physics Entrepreneurship. Designed to empower physicists as entrepreneurs, the program features targeted physics study, practical business instruction, and actual experience in an entrepreneurial environment. We believe that this approach has great promise as a new paradigm for graduate education in the sciences as well as providing a new model for technology transfer. Lawrence Krauss will present an overview of the history and motivation for the program; Cyrus Taylor will then discuss the details of the ongoing program.”

#### *Divisional Meetings*

Members of the Advisory Committee met for the remainder of the afternoon with staff of the various MPS Divisions.

At the conclusion of these discussions, the meeting was adjourned for the day.

### **Friday, April 13, 2001 Morning Session**

Kirk called the meeting to order at 8:15 A.M.

#### *Status of Action Items from the November, 2000 Meeting of the MPSAC*

Dr. Morris Aizenman, Senior Science Associate of the Mathematical and Physical Sciences Directorate, presented an update on action items from the previous meeting (November 2000). The following items were reported:

- The Education Subcommittee of the Advisory Committee report is writing a report on educational activities and opportunities. The report is not finished but is expected before the next meeting.
- A matrix showing involvement of the MPS Divisions with the various MPS science themes was provided to the AC in the handout material.
- A copy of the NSF enabling legislation was provided in the AC material.
- There are numerous sources of employment statistics for the MPS disciplines, many of which are available on the web accessible. Some material was handed out to the AC.
- A request for demographic data emerged from the GPRA discussion at the last meeting. This information will be prepared for presentation with the FY 2001 MPS Directorate GPRA Report.
- The Education Subcommittee was to make contact with the EHR directorate. Aizenman asked Dr. Lon Mathias, a co-chair of the Subcommittee to summarize the situation. Mathias stated that:
  1. The research and education communities suffer from lack of communication.
  2. There is strong interest on the part of President Bush and of the Congress to improve education, therefore there is a mandate here for MPS to engage the problem.
  3. Education must be tied more strongly to research.

#### *Invited Presentation III*

Dr. William Y. Arms, Professor of Computer Science at Cornell University, gave an invited presentation entitled “*The Impact of the Internet on Research Universities: Examples from Distance Education and Digital Libraries.*”

Arms explored the hypothesis that modern technology is reshaping research universities and looked at some data about what is happening today. He described two activities that he was personally involved with: (a) eCornell, the distance learning company at Cornell, and (b) the NSF's digital library for science, mathematics, engineering and technology education.

He discussed the economics and intellectual property rights associated with distance learning. He noted that MIT will provide free access to all their web-based courses within 10 years. Arms went on to discuss developments in digital libraries and electronic publishing, the associated economics, the fundamental



rationale for publishing scientific works, the impact on the peer review process, new search engines, protocols and standards, meta-data standards, and more.

Among the other issues raised were:

- Where will the “one pivotal teacher” come from in the new age of education? Arms stated that he does not recommend the limit of no contact teachers, but noted that we probably can move a lot farther (from our current position). An AC member noted that we could lose the role model if we let technology get too far in front.
- Education versus knowledge transfer and the value of dialogue (student-teacher and student-student) – How can internet education deal with this issue? One AC member felt that the classroom should and will become the place for judgement and discussion and that technology will take over the information transfer role. In that limit, we will need better teachers. This thought was echoed by a number of the AC members.
- How will intellectual property rights of faculty be defined with respect to the university? A general discussion of property rights of web-based material ensued.
- In the social context, will the “digital divide” between the wealthy and the poor become greater or narrow? Arms felt that technology has improved access to education, unequivocally, siting improvements in access by third world countries.

*Presentation of the Division of Mathematical Sciences (DMS) COV Report*

Dr. William Pulleyblank of IBM and Chair of the COV that conducted the review presented the Report of the COV for the Division of Mathematical Sciences. The COV was made up of 32 mathematicians broadly representative of the field.

Dr. Pulleyblank began his presentation by commenting on the great opportunities in the mathematical sciences, particularly the successes, results, interconnections with other fields. Opportunities are even greater now with the availability of digital data of a totally new scale, new and emerging computer platforms, and high-speed, global communications. He commented on the supply of mathematicians. Over the period 1992-1999, the number of mathematics graduate students has declined by 25%, including the number of US graduate students, and the number of math majors taking upper division courses. The NSF role in support of mathematics has risen to 70% of the total US support.

The COV reviewed the structure of the NSF Mathematics Initiative and found it balanced with respect to fundamental and applied mathematics, and connected to other science disciplines and to mathematics education. The COV enthusiastically endorsed the Mathematics Initiative.

DMS COV findings included the following:

- The use of screening/triage panels in several areas was found to be very useful in processing proposals;
- In view of Review Criterion 2, Program Directors appeared to have the primary responsibility for, and had done a good job of, folding the broader impact of a proposal into the decision process;
- The idea of mathematics institutes, each with a different character, focus, and mode of operation was seen as good for the field and the possibility of more such activities was viewed positively;
- Funding of interdisciplinary activities should appropriately come from both sides, and the COV cited the examples of recently developed plans to cooperate with the National Institutes of Health (NIH) and the National Institutes for General Medical Sciences (NIGMS);
- The mentoring program for new Program Officers should be expanded;
- The CAREER program was seen as important and should be expanded (by the addition of more funding) in order to be more effective;
- The Grant Opportunities for Academic Liaison with Industry (GOALI) and the Interdisciplinary Grants in Mathematical Sciences (IGMS) were seen as good programs but appeared to be lacking in quality applicants and needed to be promoted more vigorously;
- The program of Research Experiences for Undergraduates (REU) Site and supplements were seen as good programs and should be expanded;

- Improved communication and public education activities would broaden support for mathematical sciences and the Mathematics Initiative, and would increase the attractiveness of research careers in this area (e.g. through web-presence and web-accessible lectures);
- The NSF should invest in a program to address the attrition in U.S. mathematical science students;
- With the diversity problem far from solved, the work of successful departments in this area needs to be rewarded, and more resources are needed to build the infrastructure in minority serving institutions;
- Lastly, the COV had high praise for the DMS Program Directors, Executive Officer, and Division Director.

The overall COV assessment regarding the Division with respect to the GPRA Outcome Goals of People, Ideas, and Tools was that the Division was rated as “*Successful*” in each of the three areas. The COV also considered the DMS balance among programs, priorities, and future direction, and gave the Divisional leadership high praise.

*MPS Advisory Committee Discussion of the Division of Mathematical Science’s COV Report*

One member commented that he was impressed by the recommendation for increased support of young people. Another expressed surprise at the COV recommendation that DMS fund more centers (with a possible result that there would be less support for individual investigators) and asked why this view was held by the COV. Pulleyblank noted that the three current centers are having a very strong impact on the field. Another member applauded the DMS outreach to other disciplines. He commented that the GOALI problem might rest on the issue of intellectual property rights that companies might lose very easily. Concern was expressed about the REU program (the COV had rated this program highly and had called for an expansion of the program) because it has never undergone a serious assessment of impact. If the program was effective, why was attrition so high in mathematics? Pulleyblank felt that the REU program might not be adequate and may not have been in existence long enough to affect attrition. Dr. John Hunt, Deputy Assistant Director for Integrative Activities within the Education and Human Resources (EHR) Directorate, noted that a rigorous evaluation of the REU program was being planned.

One member felt that linkages might be sought between new or existing mathematics institutes and Historically Black Colleges and Universities (HBCUs) and minority-serving institutions. Hunt commented that each year there are 21,000 undergraduate degrees awarded by Minority Alliance Institutions, yet only 2000 of these transition to graduate school. A comment was made that it was essential for the science community to visit HBCUs. For example, Xavier University graduates more chemistry majors each year than the University of Michigan, despite the great disparity in department size between the two institutions. One needs to understand and assess the balance of resources prior to making recommendations.

Pulleyblank, in response to a question, stated that the number of women receiving PhDs in mathematics was increasing. He noted, however, that this was not the case for underrepresented minorities.

A member commented on the balance of support between individual investigators and Centers/Institutes. He was happy to see the COV recommendation on the importance of centers and noted they play a big role in improving diversity and K-12 education. Pulleyblank added that the COV recommendation was for a broad range and scope of institutes. He noted that both the US and Canada have three such institutes, despite the ten-fold disparity in populations.

*Acceptance by the MPSAC of the COV Reports for the Division of Mathematical Sciences and the Division of Chemistry*

Kirk asked for any expression of reservations or concerns about the Division of Mathematical Sciences COV report. Hearing none, he called for a vote on acceptance and endorsement. It was so moved and seconded. The vote was unanimous for accepting and endorsing the report.

He then called for similar motions regarding the Division of Chemistry COV Report reported on the previous day. The MPSAC report vote was unanimous for accepting and endorsing the report.

*MPS Advisory Committee Divisional Reports*

Advisory Committee members who attended the various meetings with the MPS Divisions on Thursday afternoon, April 12, 2001, reported on the meetings.

Division of Astronomical Sciences (AST)

Tony Tyson reported that this is an exciting time for astronomy as a result of unique opportunities resulting from close collaborations with the physics community. An example is the study of dark energy. A problem for the field is the presence of a bimodal funding pattern due to the existence of private funding sources. Additionally, NASA, which supports space-based astronomy, has a budget for support of individual investigators that is about five times that of the NSF budget. Furthermore, grant support by NASA is increasing at a rate greater than that of NSF.

In some areas the U.S. is losing its lead in astrophysics to Europe and Japan. The European Southern Observatory (ESO) is supporting four 8-meter aperture adaptive optics telescopes at Paranal, Chile. The telescopes are valued at over one billion dollars. Japan has a giant 8-meter telescope on Mauna Kea, Hawaii. Californians have access to most of the time on the twin 10-meter Keck telescopes on Mauna Kea. Many highly qualified astronomers and astrophysicists are not being supported due to lack of funds.

Bright spots for the US are the Gemini North facility on Mauna Kea, Gemini South in Chile, and the proposed Atacama Large Millimeter Array (ALMA). Funding for the design of ALMA had been in NSF's Major Research Instrumentation budget category, but in FY 2002 it would be within the AST Budget Request and accounts for most of the 5% increase in the Request.

At the request of the Office of Management and Budgets (OMB) a National Research Council panel is looking into the pros and cons of transferring NSF astronomical support activities to NASA. This is being considered in part because projects are becoming large, and NSF does not have much experience with managing large facilities.

Tyson expressed concern that there was no formal review process in place at NSF, while at NASA there are weekly meetings looking to the future and creating implementation plans. While AST has a good grasp of the astronomy community's ideas, it has no discretionary money to implement them.

Division of Chemistry (CHE)

Lila Gierasch observed that all the issues raised by the recent COV for CHE pointed out the need for more funds. Examples include the decline in the number of graduate students supported and the proportion of junior versus senior investigators. The COV's concern about the lack of reviewer comments on Criterion 2 may have been biased by the pool of proposals they examined, which included jackets processed three years ago. Current proposals and reviews do a better job of addressing Review Criterion 2.

With respect to the problem of more community attention to Review Criterion 2, it was felt that CHE consider sponsoring workshops at national American Chemical Society meetings to raise the community's consciousness on Criterion 2 issues. There should also be a separate section in the proposal that requires the PI to address this criterion. Gierasch noted that panels require more support staff effort while mail reviews require more scientific staff time. Panels are better at addressing interdisciplinary issues and Criterion 2 issues. Marginal proposals also benefit from panel considerations. She suggested consideration of a triage system to weed out proposals that are not likely to be funded.

With respect to the relative scarcity of CHE principal investigator participation in initiatives, she recommended that CHE consider having workshops at American Chemical Society (ACS) meetings to educate and provide an incentive to the community. She suggested that K-6 and K-12 education issues are vital to addressing pipeline concerns and recommended that CHE work with the Education and Human Services Directorate in dealing with these issues. CHE must find a way to describe the many connections

chemistry has to other fields. The chemistry curriculum is a major problem. The current curriculum sustains barriers within various fields of chemistry and contributes to the insularity of chemistry from other fields.

#### Division of Materials Research (DMR)

Julia Phillips noted that they had had only one hour to meet with DMR staff due to a meeting of the Education Subcommittee. During that time they had discussed possible FY 2003 Areas of Emphasis in terms of the NSF Government and Performance Act (GPRA) Outcome Goals.

PEOPLE: It was felt that since the DMR has no direct link to K-12 education, it must find special opportunities to provide input into the determination of science curricula in terms of “science affecting daily life.” Because of the unique role NSF has with respect to science education DMR should take a lead role using already existing connections between activities it is supporting and such activities. DMR could consider creating centers that would link research and education but with support periods shorter than that provided the Materials Research Science and Engineering Centers (MRSECs). It was also noted that some type of support is needed for students in the summer between undergraduate and graduate schools.

IDEAS: Phillips noted that DMR interests are complementary to the Department of Energy (DOE) Basic Energy Science and the Department of Defense (DOD) funding portfolios. There is, however, awareness amongst the agencies of each other’s thrusts. DMR is a leader in international activities and is encouraged to continue. Materials science shares frontiers with the Biological Sciences (BIO) and Engineering (ENG) Directorates. Examples are green manufacturing or manufacturing across length scales. Research on quantum phenomena is complementary to research in nanoscience. Computational work is increasingly important.

TOOLS: Examples of areas of future emphasis cited by Phillips were control at the atomic scale, Internet experiments at a distance, shared facilities, and instrument development.

OTHER MATTERS: Compliance with respect to Criterion 2 has improved over the last year. NSF has no data on the gender or ethnicity of students, so the progress of underrepresented groups through the pipeline cannot be checked.

#### Division of Mathematical Sciences (DMS)

Tony Chan noted that the FY 2002 budget for DMS was exciting and there is an increasing realization of the potential mathematics has for other sciences. Future emphasis in DMS should be on adequately funding awards rather than making more awards.

It was felt that DMS should provide the Advisory Committee with a draft document concerning use of NSF Review Criterion 2 in proposals and in the evaluation of proposal. This could be based on a document the Office of Polar Programs (OPP) is using. A DMS equivalent could be disseminated on the Web, through a Dear Colleague letter, or as an enclosure with review packages. They also suggested as a possible Action Items might be that the Division of Mathematical Sciences prepare a draft document concerning use of NSF Review Criterion 2 in proposals and in the evaluation of proposals to be discussed at the next Advisory Committee meeting.

The Vertical Integration of Graduate Research Education (VIGRE) has had a major impact on mathematics departments and culture. DMS staff was overworked and this was due in part to their willingness to participating in a number of new initiatives. The AC should take the time to have a discussion on possible Mathematics/Science partnerships. The Interdisciplinary Grants in the Mathematical Sciences (IGMS) program should be expanded to all levels in the education pipeline. A mechanism should be developed for two-way exchanges between U.S. and European students for training and experience. DMS should also explore means of increasing interactions with other centers supported within MPS. Computational science should become part of all of the MPS Divisions. Siegmund noted that the mathematics community is

pressing for new programs, and DMS has been responsive. There was no doubt that the division needed more personnel.

#### DIVISION OF PHYSICS (PHY)

Jim Gates began his report with a discussion of educational activities. There is an enhanced recognition within the physics community of the importance of this issue, and there are active programs underway by individual principal investigators, centers, and major facilities. An example is an internet-based database in high-energy physics for interested students. Both of the Laser Interferometer Gravitational Wave Observatory (LIGO) sites have outreach programs for underrepresented groups (the Hanford site has a program for native Americans and the Livingston site has a program for African Americans).

In other PHY activities, it was noted that the Physics Frontier Centers, for which 50 pre-proposals have been received (only four will be selected for support) will have another competition next year. There is much interest in the community in establishing a world-class underground facility in a gold mine in South Dakota. LIGO is expected to be a spectacular success. However, a recent earthquake set the commissioning back several months.

A major concern is staffing within the Division. Turnover of staff in the Division is unusually high this year and raises concerns in the community about stability. In addition, program officers must spend a large amount of time on interdisciplinary issues, and research programs are more difficult to manage.

The Division is maintaining a good program balance, but the margin on funding decisions is rising. The balance between centers and individual investigator grants is being tracked, with the relative values of supporting large center, which would mean a decrease in the funds available for support of individual investigators, being examined.

#### *Announcement of the MPS Advisory Committee Chair for October 1, 2001 – September 30, 2002*

Eisenstein thanked Advisory Committee members whose service on the Committee would be ending September 30, 2001. He also expressed his thanks to Tom Kirk, this year's Chair of the Advisory Committee, and announced that Billy Joe Evans would serve as the Advisory Committee Chair for the period October 1, 2001 – September 30, 2002.

#### *Lunch Discussion with Mr. Curt Suplee, Head of the Office of Legislative and Public Affairs*

Mr. Curt Suplee, Head of the Office of Legislative and Public Affairs (OLPA), joined the MPS Advisory Committee for a discussion of activities in his office.

Much of the discussion centred on the future of the RISE document. Kirk expressed concern about the time it was taking to publish an NSF-wide version of this document. Others suggested that the RISE document might be something that could be published by the American Institute of Physics. Suplee responded that NSF's Deputy Director did not want multiple copies of RISE-like documents being issued by the separate Directorates. He wanted a single NSF-wide document, and the delays were the result of waiting for input from some of the Directorates. Suplee wished that the document were further along, and told the Committee that it would be completed by the end of June. Evans stated that the MPS Advisory Committee had committed itself to seeing that a document was produced, and stated that the Committee would help in whatever way it could.

Tyson noted that for years he had heard that NSF couldn't promote itself, yet NASA does exactly that. Suplee responded that NSF does not do PR, it does public information. He added that OLPA wanted to help get the message of the importance of science out to the general public, and that his office would become more proactive with reporters. He felt it was important that the office provide explanatory information and kits when significant results were released. It was important for NSF grantees to tell the Foundation when interesting results were about to be released so that NSF could provide illustrations in

advance. He noted that at professional scientific meetings there were world-class scientists making presentations, and that OLPA wanted to be present at these meetings, videotape the talks, and, along with illustrations, put this material on a web site in order that it become a teaching and learning tool.

Evans felt that every MPS Division should have a list of funded projects plus the societal impacts of these projects. Gierasch noted that in the United Kingdom it was a requirement that projects be explained in language the layperson could understand. Goodchild pointed out that in the United Kingdom there was a Council on the Public Understanding of Science, and that there was a more advanced network for publishing such information. Kirk noted that the Directorate's Program Directors play an important role in determining what should be part of the activities featured by OLPA.

The Committee thanked Mr. Suplee for taking the time to join them for this discussion.

**Friday, April 13, 2001**  
**Afternoon Session**

*Science and Education Themes*

John Hunt, Deputy Assistant Director for Integrative Activities in the Education and Human Resources Directorate (EHR), and Norman Fortenberry, Division Director for the Division of Undergraduate Education (EAR) and Acting Division Director of the Division of Human Resource Development in (EHR) joined the Advisory Committee for questions and discussion on science education research and the role of research scientists in the Math and Science partnership. Fortenberry described efforts in physics, engineering, and chemistry. Chan asked as to what role research scientists could play in the administration's Math-Science Partnerships. Hunt replied that first and foremost the Partnerships would address teacher training. He noted that research experiences inspire teachers as well as students. Fortenberry described the main areas of the Partnerships and activities that already exist to foster Partnerships. There was general discussion on links of NSF-funded projects to other (non-academic or non-funded) types of science sites and on the problems of recruiting and retaining future scientists from underrepresented groups

*Report of the MPSAC Education Subcommittee*

The Education Subcommittee presented its report. It recommended that it be renamed the Education Liaison Group and that its roles should include:

- Input, feedback, and suggestions to MPS on education issues;
- Guiding or conducting the interface with MPS divisions, EHR, and the Department of Education on these issues; and,
- Coordinating MPSAC efforts to assess and evaluate educational components of MPS programs, centers, and activities.

During the discussion the following possible action items and discussion topics were suggested:

- Providing support for scientists to go into K-12 classrooms, perhaps with scientists "adopting" a class (Example: Zavala Young Scientists in Austin, Texas);
- Seeing that successful model projects receive wider dissemination and adoption;
- Modeling how to teach investigation; and,
- Use of web resources.

*FY 2003 Budget Areas of Emphasis*

Eisenstein stated that the budget request for FY 2003 will soon be drafted and that the National Science Board (NSB) meeting in June would be devoted to discussion of this issue. He asked the Advisory Committee for intellectual and educational issues that particularly need attention in the FY 2003 budget.

These following themes and issues emerged during the discussion:

- Computational science and its integration with other sciences are major issues for most disciplines.
- The three main themes from RISE should be reiterated. The RISE document should move ahead.
- MPS frontiers with engineering and manufacturing should be developed and encouraged.
- MPS Major Research Equipment (MRE) projects need to be included in the list of science and engineering tools. Priority setting for MRE projects is an issue, and this included the question of how MPSAC should advise on these priorities.
- Large databases and data sources are increasingly important to both scientific advances and informing/attracting the general public.
- How can the NSF identify successful projects and practices in training and education? How can we disseminate these good ideas more effectively?
- Institutes for education and communication are presented in the MPS “Areas of Emphasis” document provided to the AC, with emphasis on astronomy. Some committee members advocated that this concept of institutes should be expanded to other disciplines.
- The MPS/BIO partnership should be emphasized, and should include all MPS fields along with problems such as bio-informatics that need collaborative attention from the Directorate for Biological Sciences (BIO), the Directorate for Computer & Information Science & Engineering (CISE), and MPS points of view.

The meeting was adjourned at 3:30 P.M.

#### *Action items*

Following the meeting a series of emails was exchanged by members of the Advisory Committee. In an email to Aizenman dated 25 April, 2001 the Chair of the Advisory Committee provided a list of Action Items for inclusion in the Minutes:

#### **Action Items Requested by Advisory Committee:**

**(ACTION ITEM 1) The RISE Document as it has been expanded to the whole of the NSF directorates should be completed and a way found for it to be issued by the NSF and endorsed by the NSF Advisory Committees within the second quarter of Calendar 2001.**

**(ACTION ITEM 2) NSF MPS representatives should consider using national meetings to NSF advantage to disseminate information and serve two purposes:**

- **The community of potential PIs and reviewers could be better informed about the review process. Open discussions of Criterion 2, for example, could help to make prospective PIs and reviewers more effective at judging and presenting issues related to this criterion. Mock panel reviews may be helpful; these could be held at national meetings.**
- **National meetings provide excellent opportunities to announce new funding opportunities and to explain existing programs.**

**(ACTION ITEM 3) NSF should study the possibility of convening a study panel to enhance the recruitment of graduate students into the disciplines that are suffering serious declines (such as Chemistry and Mathematics).**

**(ACTION ITEM 4) NSF should make arrangements for the compilation of a reliable database on the participation women and minority graduate students and post docs in NSF-funded research, as well as any other data that is required for a quantitative assessment of NSF progress against GPRA goals.**

**(ACTION ITEM 5) MPS should prepare a clear 'Charge' to the MPSAC in advance of AC Meetings with specific questions the AC is asked to address.**

**(ACTION ITEM 6) NSF should prepare (or identify) a public database for the dispersal of public grant funds.**

**(ACTION ITEM 7) NSF is asked to describe the mechanism it has, or is now developing, for the study, evaluation, selection (with community input), and planning of new MRE projects.**

**(ACTION ITEM 8) NSF is asked to describe how it plans to use EHR support in collaboration with MPS and other divisions, to effectively reach out to 'all Americans'; in particular, how to address the open channel of curiosity about the universe and the environment as a mechanism of engaging curious minds of all ages in science and the scientific method.**

**(ACTION ITEM 9) Our nation is currently experiencing a critical shortage of optics engineers and scientists, a supply and workforce training problem. A key element is that universities do not have a clear "optics" program at NSF to apply to, in order to get support. Possibly, an NSF-created virtual optics program composed of links to existing programs on ENG and PHY would solve or mitigate this "portal" problem.**